Resonant laser ionisation of Astatine at ISOLDE-CERN

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Outline

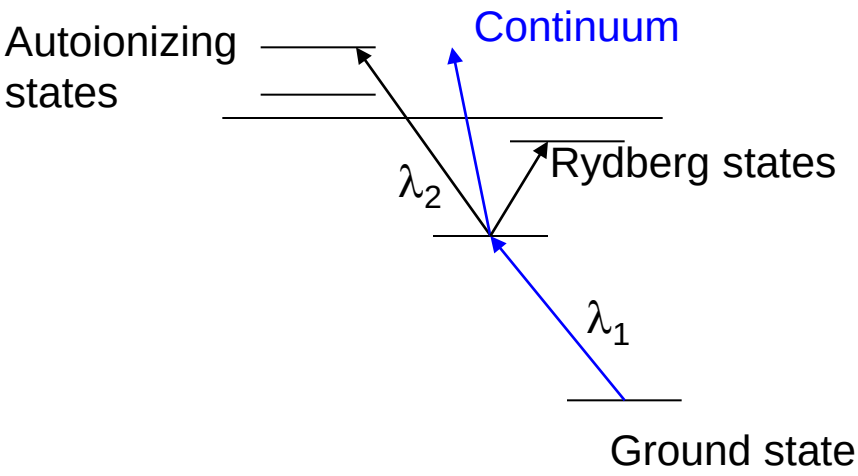
- Introduction
- What did we know?
- Experimental method
- Results
- Conclusions & Outlook

Introduction

Development of intense and pure At beams at ISOLDE.

- How? Resonant laser ionisation
- Examples of possible research activities
  - β-delayed fission of ^{192,194,196}At
  - Laser spectroscopy: investigation of ground state properties of At

Pure beams with resonant laser ionisation.



- Element specific
- Problem: No stable At isotopes → not much atomic information on At.

What did we know?

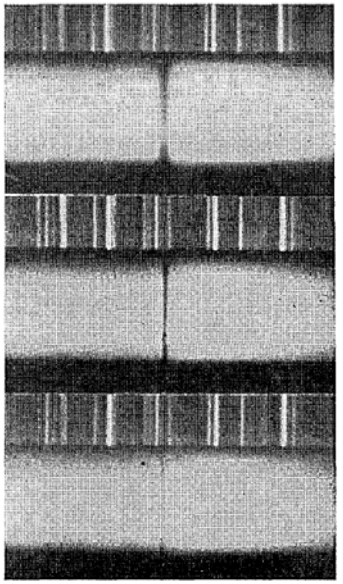
Time after implantation

224nm line

11.75 h

35.42 h

54.05 h

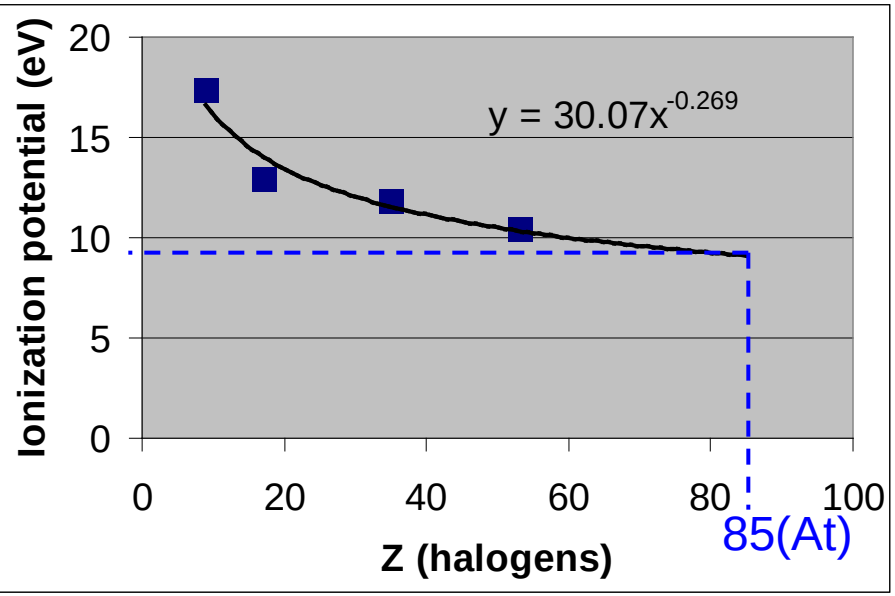


Step 1: excited levels

From optical measurements :
determination of two excited levels at 2244.01 Å and 2162.25 Å.

R. McLaughlin. *Optical Society of America*, 54 (**1964**) 965

Step 2: ionization potential

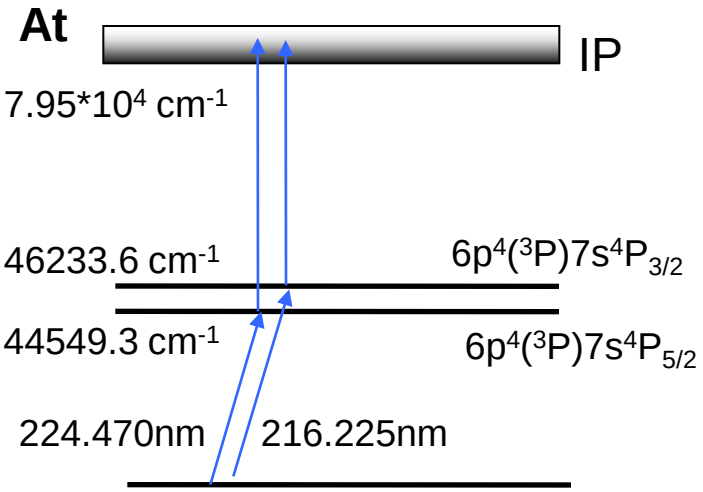


Ab initio calculations: 10.4 eV[1], 9.2 +- 0.4 eV[2], 9.86 eV[3]

[1]Y.P. Varshni, Zeitschrift für Physik 135 (1953) 512.
[2]W. Finkelnburg, W. Humbach, Naturwiss. 42 (1955) 35
[3]E.P.F. Lee, T.G. Wright, Chem. Phys. Lett. 374 (2003) 176.

Extrapolation (see figure): ~ 9.1eV

Experimental method

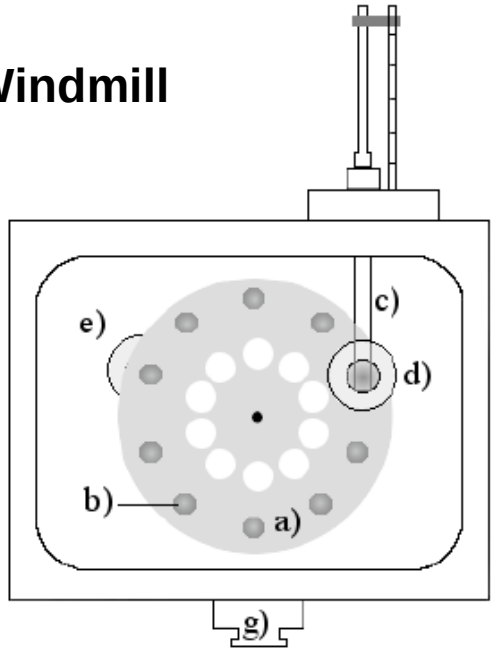


1.4 GeV protons at ~0.3μA on 150gcm^{-2} UC_x target.

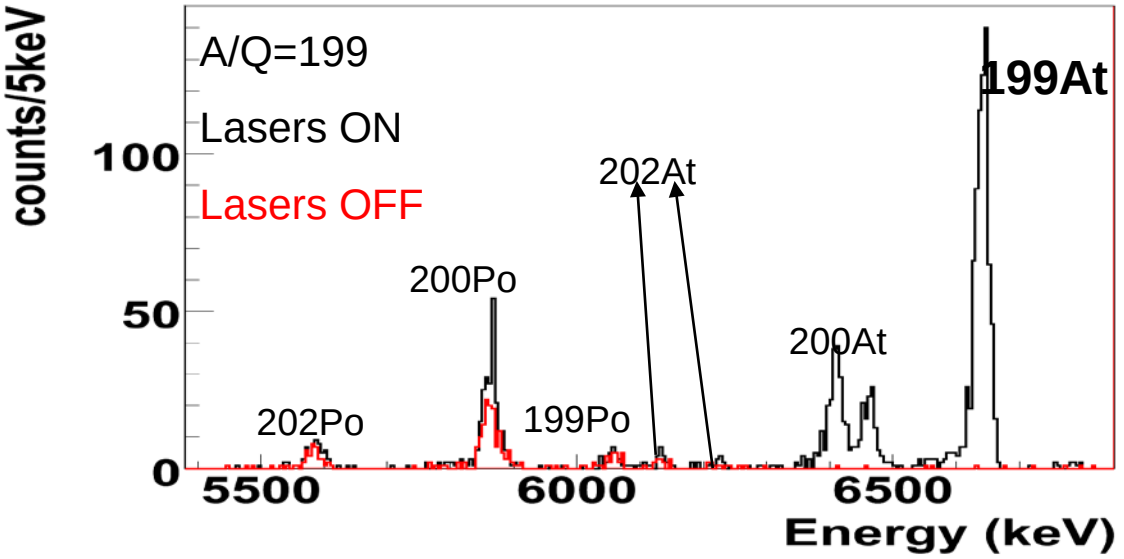
Mass separator on ^{199}At:

- In-target σ = 0.64 mbarn (from simulation)
- $T_{1/2}$ = 7.03s
- Single α-line at 6643 keV (branching ratio ~ 90%)

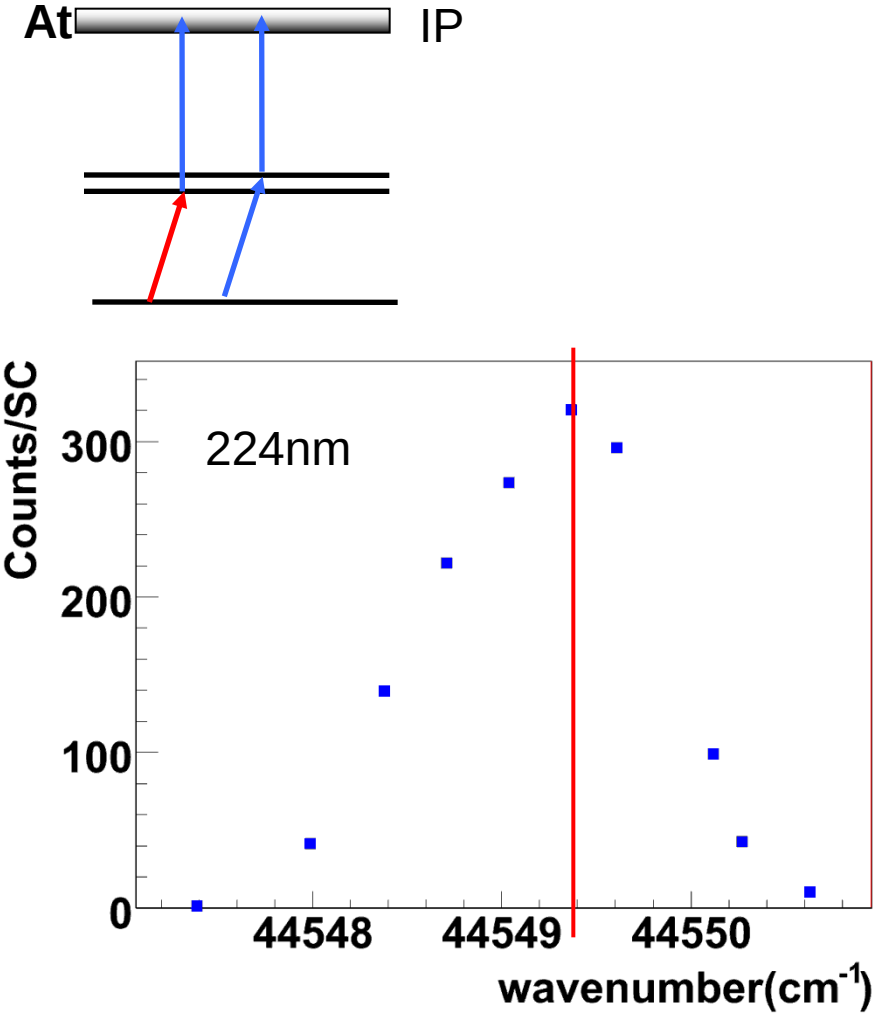
Windmill



Maximum yield ~ 5x10² ions / μC

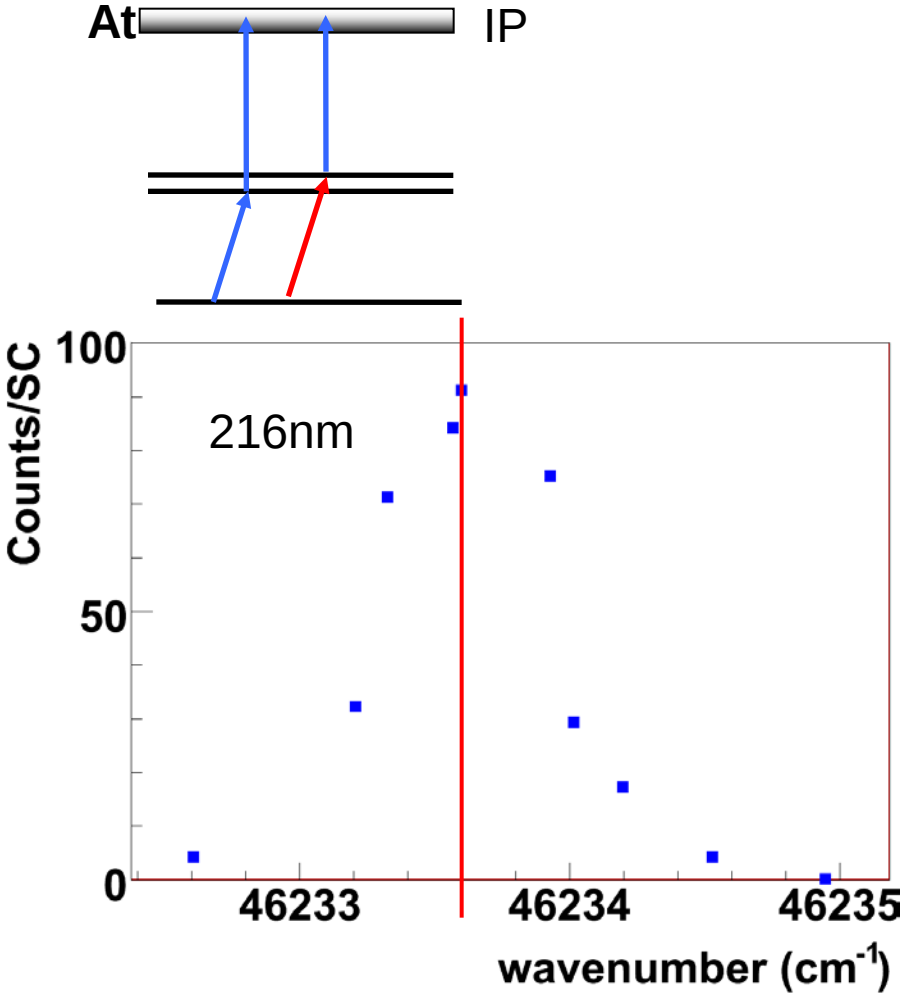


Results I (preliminary)



Resonance at 44549.4 cm^{-1}

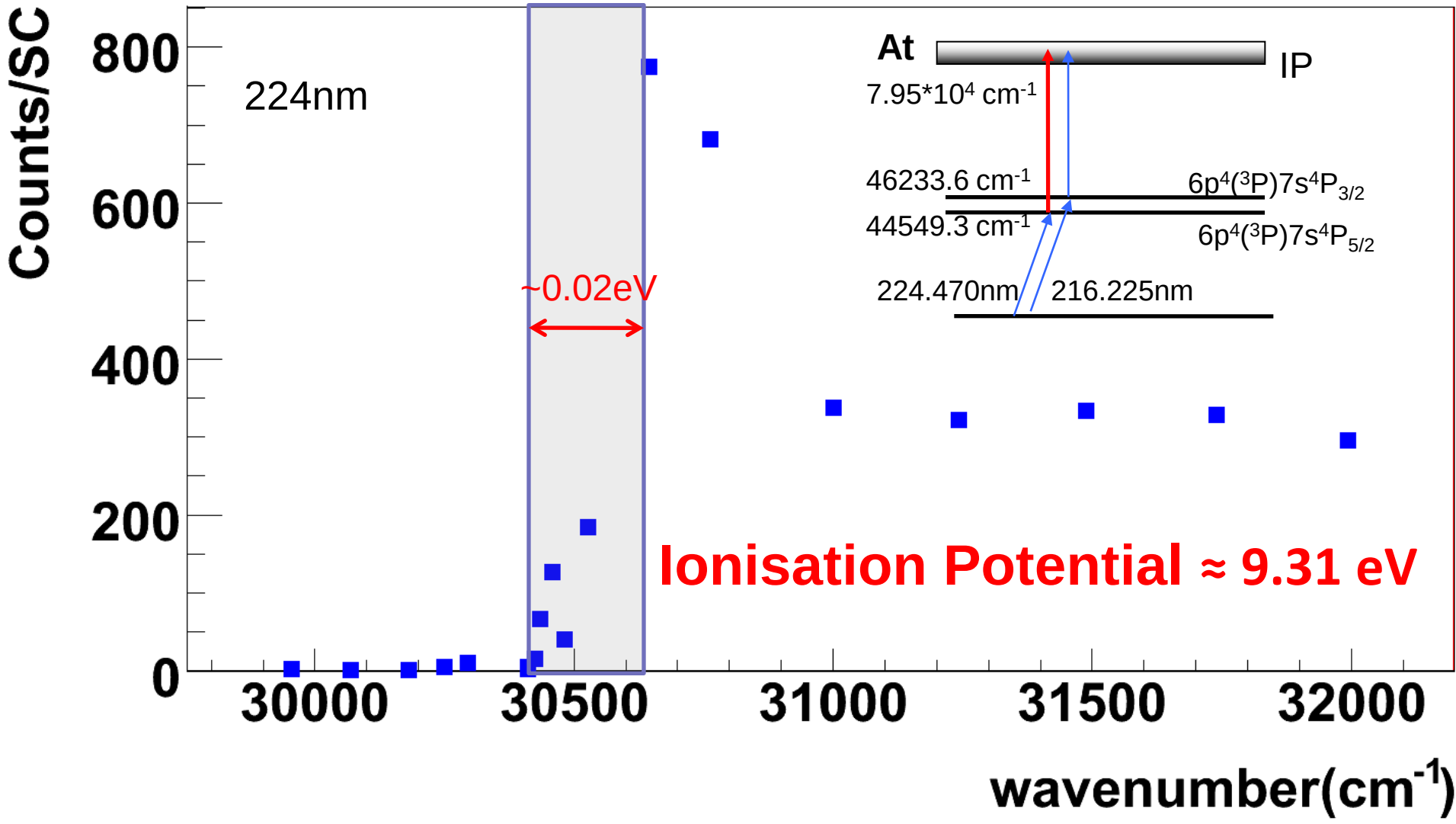
Mc Laughlin, 1964 : 44549.3 cm^{-1}



Resonance at 46233.6 cm^{-1}

Mc Laughlin, 1964 : 44233.6 cm^{-1}

Results II (preliminary)



Conclusions

- First-step transitions At confirmed
- IP determined
- Pure At beams now available at ISOLDE-CERN

Outlook

- Development of 3-step ionisation scheme at TRIUMF (Vancouver, Canada). Preliminary: **40 times more efficient** scheme found!
- Nuclear physics experiments are possible from now on

acknowledgements

S. Rothe[1,3], B. A. Marsh[1], A. M. Sjödin[1], V. N. Fedosseev[1],D. V. Fedorov[2], S. Raeder[3], K. D. A. Wendt[3], J. Lassen[4] , M. D. Seliverstov[6] , Yu. Kudryavtsev[6]
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Questions?